

The filmy fern *Hymenophyllum reinwardtii* (Hymenophyllaceae) newly recorded for Australia.

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Abstract

The Malesian species *Hymenophyllum reinwardtii* is reported as a new record for Australia. This distinctive filmy fern can be recognized by the undulate and dentate lamina margins, the undulate and dentate rachis wing, and the circular indusial flaps whose margins are usually irregularly and sparsely denticulate or rarely entire. The species was collected in the vicinity of the summit of Mt Finnigan in June 2017, and is currently known in Australia by this one gathering.

Introduction

Hymenophyllaceae is an early diverging lineage of leptosporangiate ferns (Rothfels *et al.* 2015) including some 435 extant species (PPG I, 2016) characterized by their thin (usually one-cell thick) lamina, pubescent rhizome and marginal indusiate sori (Ebihara *et al.* 2007). *Hymenophyllum* Sm. comprises one of two main clades within the family, circumscribed by its long-creeping rhizomes with pale hairs and valvate indusia surrounding a usually non-protruding receptacle (Ebihara *et al.* 2006, 2007; Herrera *et al.* 2017). Nineteen species occur in Australia, of which eight species and one variety are endemic (Bostock and Spokes 1998); the highest regional diversity occurs in the wet tropics of north-east Queensland.

The north-east Queensland tropical flora has two major contributing biogeographical components: species with origins in Sahul – the Australian plate that has rafted northward following separation from what is now Antarctica; and species with origins in Sunda – the Southeast Asian plate (Hall 2002; Crayn *et al.* 2105; Yap *et al.* 2018). Dispersal of lineages from Sunda to Australia began before the Quaternary (Crayn *et al.* 2015), and is ongoing (Yap *et al.* 2018).

During an expedition led by the Australian Rhododendron Society in conjunction with Australian Tropical Herbarium to source *Rhododendron* L. for ex situ conservation, a distinctive *Hymenophyllum* was observed growing mixed with *H. javanicum* A.Spreng. on a large decaying log on the forest floor close to the summit

of Mt Finnigan (Fig. 1). The nearly glabrous rhizomes, pinnate fronds, and glabrous stipes put the plant in *Hymenophyllum* subg. *Globosa* (Prantl) Ebihara & K.Iwats. (Ebihara *et al.* 2006), and corresponded with *H. reinwardtii* Bosch among species of this subgenus listed by Ebihara *et al.* (2010). This identification was confirmed against herbarium material and images of type specimens, making this the first record of the Malesian *Hymenophyllum reinwardtii* for Australia.



Fig. 1. *Hymenophyllum reinwardtii* in situ on Mt Finnigan.

Taxonomic treatment

Hymenophyllum reinwardtii Bosch, Plantae Junghuhnianae 1: 567 (1853)

= *Mecodium reinwardtii* (Bosch) Copel., Philipp. Journal of Science 67: 20 (1938)

Type citation: 'Hab. in silvis elatioribus m. Tidoro, REINW.'

Type specimen: Moluccas, Maluku, Tidore, montes Tidore sylvae elatiores, Aug 1821, C.G.C. Reinwardt 1689 (L 0544684 !)

= *Hymenophyllum dichotomum* Blume, Enum. Pl. Javae 222 (1828) non Cav. (1802), *fide* Ebihara *et al.* (2010)

Description (based on Australian material): Rhizome slender, glabrous, long-creeping with widely spaced fronds. Fronds bright mid-green, 4.2–8.5 cm long and 2.1–3.4 cm wide, stipe 1.2–2.6 cm long, winged to base; wing undulate and toothed, undulations pronounced, extending all the way across the wing; margins reflexed, teeth broadly triangular, occasionally obscured due to reorientation by undulations. Lamina outline triangular, deeply 3-pinnatifid, glabrous; lamina margins crisped throughout and dentate with broad triangular teeth; rachis 0.3–0.5 mm diameter, dark brown, armed on dorsal and ventral surfaces with paraphyllia comprising small narrow-triangular to linear projections of dark-brown or green cells, more abundant on ventral surface, rachis winged, wing of main rachis crisped and dentate; ultimate segments 2–5 mm long and 0.8–1.4 mm wide, apex truncate or emarginate. Sori produced in upper half of frond, singly or in adjacent pairs, borne at the apices of lateral ultimate segments, involucre rotund, bilabiate, divided almost to the base, 1.2–1.5 mm long by 1.5–1.7 mm wide, wider than segments, margins sparsely and shallowly toothed, middle of indusium flap heavily inflated, bearing scattered papillae at base, receptacle included (Figs 2, 3).

Recognition: *Hymenophyllum reinwardtii* is a distinctive filmy fern that can be recognized by its undulate and dentate lamina margins, the undulate and dentate rachis wing, and the circular indusial flaps whose margins are weakly toothed or entire. No other Australian species shares this combination of characters. In the key to species presented in the Flora of Australia (Bostock and Spokes 1998), *Hymenophyllum reinwardtii* will fail to progress, because at couplet 6 the frond margin is coarsely dentate, which leads to a group of four dissimilar species with finely toothed lamina margins, among which it keys to *H. gracilescens* Domin. We propose a modified key to species that accommodates *H. reinwardtii* below.

Distribution and ecology: Widespread through Malesia from at least the Philippines to Papua New Guinea. Most specimens have been collected in montane rainforest. In Australia, *Hymenophyllum reinwardtii* is known only from the vicinity of the Mt Finnigan summit, where it grew on a large decorticated decaying log on the forest floor in the head of bouldery gully, mixed with *Hymenophyllum javanicum*. The two *Hymenophyllum* species formed a discontinuous tall turf on the top and sides of the log mixed with *Thuidium* Schimp. and *Trichocolea* Dumort. (Fig. 1).

Notes: Morphological diversity exhibited by the suite of specimens examined (cited below) suggests that *Hymenophyllum reinwardtii* is evidently a complex comprising a range of forms, some of which exhibit altitudinal separation. Until such time as detailed study of patterns of variation is completed, we accept a broad circumscription for this species and attribute Australian material to it in that sense.

Conservation Status: In Australia, *Hymenophyllum reinwardtii* qualifies as data deficient. Despite the fact that the species is distinctive, observational data to date are too limited to make positive assertions about distribution and range in Australia, to which an informed assessment of rarity and threat is necessarily linked.

Specimens examined: AUSTRALIA: Queensland: Cook, Cedar Bay National Park, Mt Finnigan, forested gully west and immediately below summit. 15°49'8"S 145°17'5"E, 1084 m, 8 June 2017, M.A.M. Renner 8201, S. Worboys, A. Rouse, H. Hancock, T. Houghton. & L. Roberts (BRI, CNS, NSW). PAPUA NEW GUINEA: Goodenough Bay, 1908, Rev. C. King (NSW); Western Highlands District, near Tomba village, south slope of Mt Hagen Range, 2600 m, 26 Aug 1956, R.D. Hoogland 6065 & R. Pullen (NSW); Western Highlands, Laiagam subdistrict, near Kepilam village, Lagaip valley, 1 Aug 1960, R.D. Hoogland 7273 & R. Schodde (NSW); Jimi/Wahgi Divide, c. 8 km NE of Kerowagi, Bismarck Range, 2100 m, 9 Aug 1981, J.R. Croft 1367 & J.I. Marsh (NSW); Northern slopes of Mount Piora, 3300 m, 30 Aug 1975, J.R. Croft 90 (NSW); 8 km WNW of Taron, southern New Ireland, 1100 m, 10 Oct 1975, J.R. Croft 228 (NSW); Ridge E of Seitin River, 9 km WNW of Taron, southern New Ireland, 1600 m, 17 October 1975, J.R. Croft 261 (NSW); Eastern Highlands, Chimbu Divide, Goroka subdistrict, ridge above Daulo, 2500 m, 22 Nov 1954, A.G. Floyd 6366 & H.S. McKee (NSW). FEDERATED STATES OF MICRONESIA: Mt Niinioanii, Ponape, 620–700 m. 8 August 1940, T. Hosokawa 9525 (NSW). PHILIPPINES: Province of Benguet, Luzon, Mt Pulog, Jan 1909, H.M. Curran, M.L. Merritt, T.C. Zschokke (NSW).

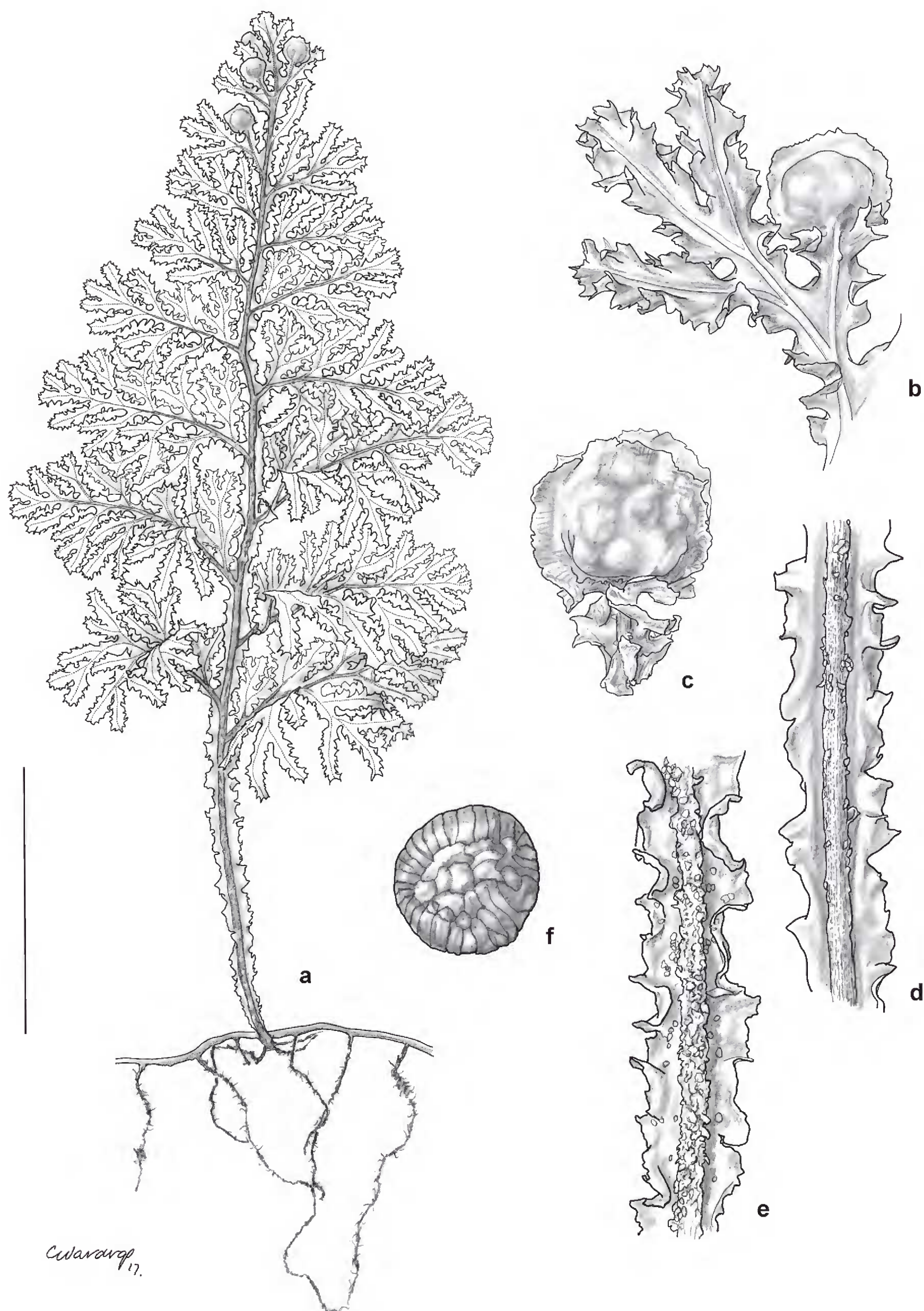


Fig. 2. *Hymenophyllum reinwardtii* A: habit; B: frond detail, adaxial surface; C: indusium; D: rachis detail, adaxial surface; E: rachis detail, abaxial surface; F: sporangia. Scale bar: a: 1.5 cm; b: 0.33 cm; c: 0.25 cm; d, e: 0.4 cm; f: 0.06 cm. All from Australian material (NSW 998108), illustration by Catherine Wardrop.

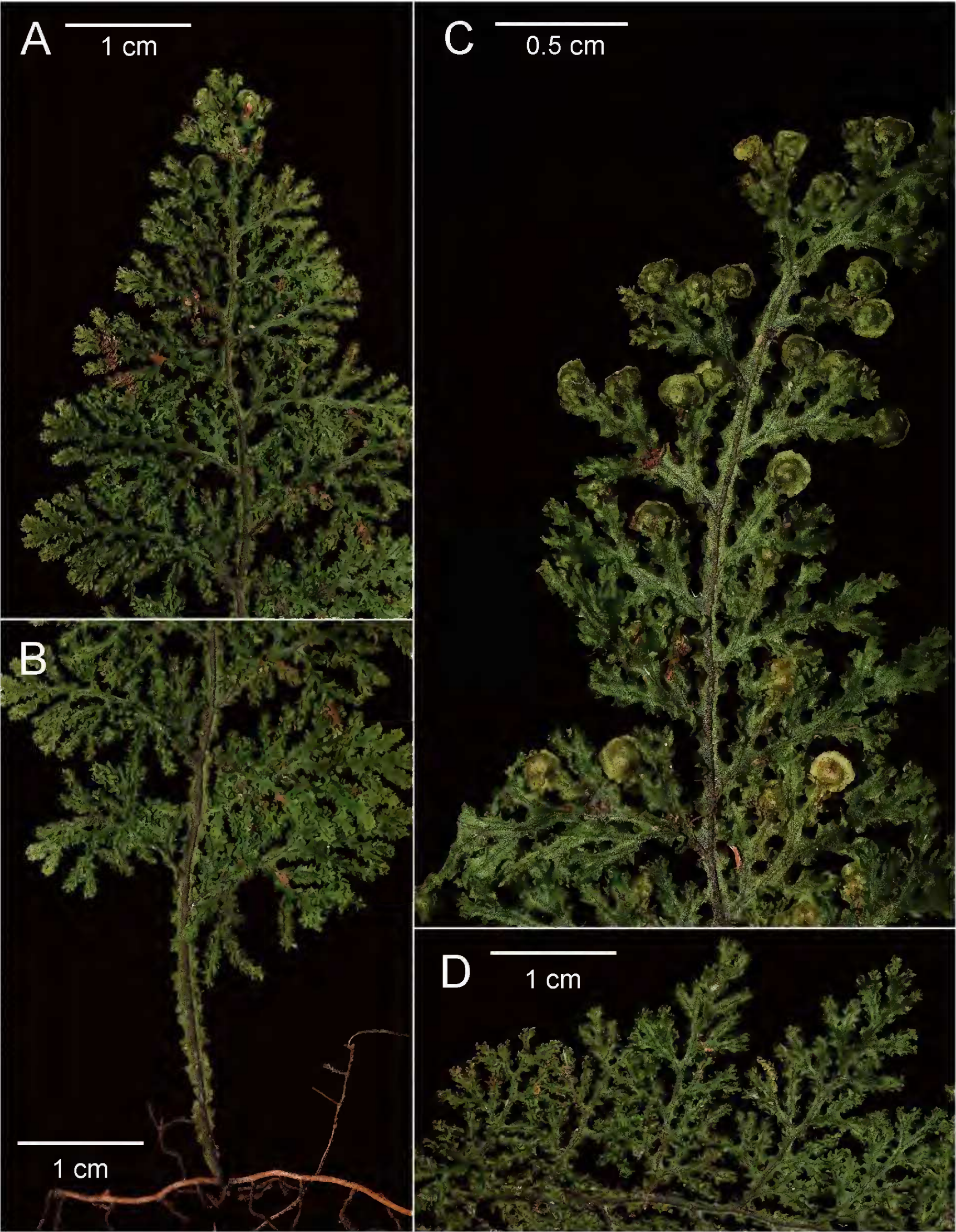


Fig. 3. *Hymenophyllum reinwardtii* A: Upper half of frond; B: lower half of frond with rhizome; C: detail of indusia and upper frond; D: sterile pinnae. All from Australian material (NSW 998108).

Revised key to Australian *Hymenophyllum*

Based on Bostock and Spokes (1998) and Andrews (1990).

- 1. Involucre with distinct cupular or obconical base, bilabiate in upper portion 2
- 1. Involucre bilabiate to middle or below, lacking a distinct tubular (cupular or obconical) base 6

2. Frond margin entire.....*H. bailey anum*
2. Frond margin toothed 3
3. Margin of involucre valve entire or at most slightly erose..... 4
3. Margin of involucre valve toothed..... 5
4. Sori as long as broad, slightly immersed at base; fronds more than 8 cm long..... *H. bivalve*
4. Sori twice as long as broad, immersed for half their length; fronds less than 6 cm long..... *H. subdimidiatum*
5. Fronds pinnatifid-pinnate; segments plane; involucre surfaces smooth *H. lobbii*
5. Fronds pinnate-bipinnate; segments crisped; involucre surfaces with prominent lamellae *H. kerianum*
6. Frond simple or 1–3 forked, entire, margins thickened and black*H. marginatum*
6. Frond pinnate, entire or toothed, without thickened and black-pigmented margin..... 7
7. Frond margins plane. Stipe winged or not..... 8
7. Frond margins undulate, usually entire but may be coarsely toothed. Stipe conspicuously winged at least in upper half..... 17
8. Frond margins toothed..... 9
8. Frond margins entire 12
9. Sori terminal on the ultimate segments of the lamina..... 10
9. Sori borne on short, specialized, lateral branches of the primary pinnae, usually confined to the acroscopic side..... 11
10. Ultimate segments usually 1.3–2 mm wide, sori few, usually 1 or 2 per frond *H. pumilum*
10. Ultimate segments mostly less than 0.6 mm wide, sori numerous, 2–8 per primary pinna at least in upper half of frond *H. gracilescens*
11. Pinnae branched only on acroscopic side, margin of involucre valves entire.....*H. peltatum*
11. Pinnae branched on both sides; margin of involucre valves at least erose-denticulate *H. cupressiforme*.
12. Lamina 1-pinnatifid, rarely 2-pinnate-pinnatifid..... 13
12. Lamina 2-pinnate-pinnatifid or more dissected 14
13. Fronds typically shorter than 30 mm, pinnae closely spaced.....*H. whitei*
13. Fronds typically longer than 30 mm, pinnae widely spaced..... *H. rarum*
14. Basal pinnae flabellate, indusia triangular-ovate, not exceeding the subtending lamina width, distributed throughout the frond, stipe sometimes conspicuously hairy.....*H. flabellatum*
14. Basal pinnae pinnate, indusia circular to ovate or obovate in outline, wider than subtending lamina or not 5
15. Indusia ovate to obovate, wider than subtending lamina, concentrated at the frond apex *H. walleri*
15. Indusia rhomboid to elliptic, equal in width to subtending lamina, distributed through upper half of frond 16
16. Involucre immersed, as wide as the subtending sterile lamina and without constriction at junction between involucre and sterile lamina*H. polyanthon*
16. Involucre free, constricted at junction with sterile lamina *H. australe*
17. Wing of stipe and rachis slightly undulate, lamina margin not undulate..... *H. australe*
17. Wing of stipe and rachis conspicuously undulate, lamina margin also undulate at least at the base of primary pinnae 18
18. Involucre ovate to oblong in outline..... 19
18. Involucre circular in outline 20

19. Margins of segments entire.....*H. javanicum*
 19. Margins of segments obscurely toothed, particularly near apex*H. samoense*
 20. Lamina margin with coarse triangular teeth *H. reinwardtii*
 20. Lamina margin entire *H. eboracense*

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References

- Andrews SB (1990) Ferns of Queensland. Department of Primary Industries, Brisbane
 Bostock PD, Spokes TM (1998) Hymenophyllaceae. Flora of Australia 48: 116–147.
 Crayn DM, Costion C, Harrington MG (2015) The Sahul–Sunda floristic exchange: Dated molecular phylogenies document Cenozoic intercontinental dispersal dynamics. Journal of Biogeography 42: 11–24. <https://doi.org/10.1111/jbi.12405>
 Ebihara A, Dubuisson J-Y, Iwatsuki K, Hennequin S, Ito M (2006) Taxonomic revision of Hymenophyllaceae. Blumea 51: 221–280. <https://doi.org/10.3767/000651906X622210>
 Ebihara A, Iwatsuki K, Ito M, Hennequin S, Dubuisson J-Y (2007) A global molecular phylogeny of the fern genus *Trichomanes* (Hymenophyllaceae) with special reference to stem anatomy. Botanical Journal of the Linnean Society 155: 1–27. <https://doi.org/10.1111/j.1095-8339.2007.00684.x>
 Ebihara A, Nitta JH, Iwatsuki K (2010) The Hymenophyllaceae of the Pacific Area. 2. *Hymenophyllum* (excluding subg. *Hymenophyllum*). Bulletin of the National Museum of Nature and Science, Series B 36: 43–59.
 Hall R (2002) Cenozoic geological and plate tectonic evolution of SE Asia and the SW Pacific: Computer-based reconstructions, model and animations. Journal of Asian Earth Sciences 20: 353–431. [https://doi.org/10.1016/S1367-9120\(01\)00069-4](https://doi.org/10.1016/S1367-9120(01)00069-4)
 Herrera F, Moran RC, Shi G, Ichinnorov N, Takahashi M, Crane PR, Herendeen PS (2017) An exquisitely preserved filmy fern (Hymenophyllaceae) from the early Cretaceous of Mongolia. American Journal of Botany 104: 1370–1381. <https://doi.org/10.3732/ajb.1700246>
 Pteridophyte Phylogeny Group I [PPG I] (2016) A community-derived classification for extant lycophytes and ferns. Journal of Systematics and Evolution 54: 563–603. <https://doi.org/10.1111/jse.12229>
 Rothfels CJ, Li F-W, Sigel EM, Huiet L, Larsson A, Burge DO, Ruhsam M, Deyholos M, Stewart CN Jr, Shaw SW, Pokorny L, Chen T, de Pamphilis C, DeGironimo L, Chen L, Wei , Sun X, Korall P, Stevenson DW, Graham SW, Wong GK, Pryer KM (2015) The evolutionary history of ferns inferred from 25 low-copy nuclear genes. American Journal of Botany 102: 1089–1107. <https://doi.org/10.3732/ajb.1500089>
 Yap J-YS, Rossetto M, Costion C, Crayn D, Kooyman RM, Richardson J, Henry R (2018) Filters of floristic exchange: how traits and climate shape the rain forest invasion of Sahul from Sunda. Journal of Biogeography 45: 838–847. <https://doi.org/10.1111/jbi.13143>